

CLAIMS

What is claimed is:

1. A system for reproducing audio signals, comprising:
 - 5 at least one source of audio signals, the audio signals corresponding to at least one audio channel;
 - a modulated signal generator configured to generate an ultrasonic carrier signal modulated with at least one of the audio signals;
 - 10 a driver amplifier configured to amplify the modulated ultrasonic carrier signal; and
 - at least one directional loudspeaker, the directional loudspeaker including at least one acoustic transducer configured to receive the modulated ultrasonic carrier signal amplified by the driver amplifier, and to project a sound beam representing the modulated ultrasonic carrier signal through a propagation medium along a pre-selected path to reproduce the at least one audio signal along at least a portion of the path.
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2. The system of claim 1 wherein the audio signals correspond to a plurality of audio channels, wherein the at least one directional loudspeaker comprises a plurality of directional loudspeakers, and wherein a separate audio channel is provided for each directional loudspeaker.
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3. The system of claim 1 wherein the audio signals correspond to a plurality of audio channels, and wherein

the modulated signal generator is configured to combine the plurality of audio channels and to generate the ultrasonic carrier signal modulated with the combined audio channels.

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4. The system of claim 1 wherein the audio signals correspond to a plurality of audio channels, the plurality of audio channels being selected from the group consisting of a first audio channel corresponding to a first location in front of a user of the system, a second audio channel corresponding to a second location in back of the system user, a third audio channel corresponding to a third location to the left of the system user, and a fourth audio channel corresponding to a fourth location to the right of the system user.

5. The system of claim 1 further including at least one sensor configured to detect a distance from the directional loudspeaker to a user of the system or to detect a position of the user relative to the system.

6. The system of claim 5 wherein the modulated signal generator is configured to generate an ultrasonic signal having characteristics based at least in part on the detected distance to the system user or the detected position of the system user.

7. The system of claim 5 wherein the sensor comprises a device selected from the group consisting of an optical

ranging device, an acoustic ranging device, and an infrared ranging device.

8. The system of claim 1 wherein the acoustic
5 transducer is selected from the group consisting of a piezoelectric transducer, an electrostatic transducer, a PVDF film transducer, and an electrostrictive film transducer.

10 9. The system of claim 1 further including a delay circuit configured to apply a relative phase shift across a plurality of frequencies of the modulated ultrasonic carrier signal to steer, focus, or shape the sound beam projected by the directional loudspeaker.
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10. The system of claim 1 wherein the system is selected from the group consisting of a television, a radio, an audio tape player, a phonograph, a compact disk player, a digital video disk player, a laser disk player, a video game, a desktop computer, a laptop computer, and an MP3 system.
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11. The system of claim 1 further including a second amplifier and at least one non-directional loudspeaker,
25 the second amplifier being configured to amplify one or more audio signals corresponding to at least one of the audio channels and to drive at least one non-directional loudspeaker.

12. The system of claim 11 wherein the modulated signal generator and the second amplifier are configured to receive the at least one audio channel in parallel.
- 5 13. The system of claim 11 wherein the modulated signal generator is configured to receive the at least one audio channel and to provide a representation of the at least one audio channel to the second amplifier.
- 10 14. The system of claim 11 wherein the modulated signal generator is configured to selectively generate the ultrasonic carrier signal modulated with the at least one of the audio signals, and the second amplifier is configured to selectively amplify the one or more audio signals, thereby allowing only the directional loudspeaker, only the non-directional loudspeaker, or both the directional loudspeaker and the non-directional loudspeaker, to reproduce the audio signals.
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- 20 15. The system of claim 1 wherein the modulated signal generator includes an independent volume control.
16. The system of claim 1 further including a remote signal receiver and a remote control device configured to generate remote signals in response to a user input, wherein the remote signal receiver is configured to receive the remote signals and generate control signals for controlling a system characteristic selected from the

group consisting of a volume setting, a tone setting, and an output switch selection.

17. The system of claim 16 wherein the remote control
5 device is selected from the group consisting of an optical remote control device, an acoustic remote control device, an infrared remote control device, and a radio frequency remote control device.

10 18. The system of claim 1 further including a fan configured to cool the system.

19. The system of claim 18 wherein the fan is activated automatically when a system temperature exceeds a
15 predetermined level.

20 20. The system of claim 1 further including a swing-arm assembly configured to mount the directional loudspeaker to a ceiling, a floor, or a wall.

21. The system of claim 1 further including a clamp assembly configured to mount the directional loudspeaker to a ceiling, a floor, or a wall.

25 22. A method of reproducing audio signals, comprising the steps of:

providing at least one audio signal by at least one audio source, the at least one audio signal corresponding to at least one audio channel;

generating an ultrasonic carrier signal modulated with at least one audio signal by a modulated signal generator;

5 amplifying the modulated ultrasonic carrier signal by a driver amplifier;

receiving the modulated ultrasonic carrier signal amplified by the driver amplifier by at least one directional loudspeaker including at least one acoustic transducer; and

10 projecting a sound beam representing the modulated ultrasonic carrier signal through a propagation medium along a pre-selected path to reproduce the at least one audio signal along at least a portion of the path by the at least one directional loudspeaker.

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23. The method of claim 22 wherein the audio signals correspond to a plurality of audio channels, wherein the at least one directional loudspeaker comprises a plurality of directional loudspeakers, and further
20 including the step of providing a separate audio channel for each directional loudspeaker.

24. The method of claim 22 wherein the audio signals correspond to a plurality of audio channels, and further
25 including the steps of combining the plurality of audio channels by the modulated signal generator, and generating the ultrasonic carrier signal modulated with the combined audio channels by the modulated signal generator.

25. The method of claim 22 wherein the audio signals correspond to a plurality of audio channels, the plurality of audio channels being selected from the group
5 consisting of a first audio channel corresponding to a first location in front of a user of the system, a second audio channel corresponding to a second location in back of the system user, a third audio channel corresponding to a third location to the left of the system user, and a
10 fourth audio channel corresponding to a fourth location to the right of the system user.

26. The method of claim 22 further including the step of detecting a distance from the directional loudspeaker to
15 a user of the system or detecting a position of the user relative to the system by at least one sensor.

27. The method of claim 26 wherein the generating step includes generating an ultrasonic signal having
20 characteristics based at least in part on the detected distance to the system user or the user position.

28. The method of claim 26 wherein the sensor comprises a device selected from the group consisting of an optical
25 ranging device, an acoustic ranging device, and an infrared ranging device.

29. The method of claim 22 wherein the acoustic transducer is selected from the group consisting of a

piezoelectric transducer, an electrostatic transducer, a PVDF film transducer, and an electrostrictive film transducer.

5 30. The method of claim 22 further including the step of applying a relative phase shift across a plurality of frequencies of the modulated ultrasonic carrier signal by a delay circuit, thereby steering, focusing, or shaping the sound beam projected by the directional loudspeaker.

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31. The method of claim 22 wherein the system is selected from the group consisting of a television, a radio, an audio tape player, a phonograph, a compact disk player, a digital video disk player, a laser disk player, 15 a video game, a desktop computer, a laptop computer, and an MP3 system.

20 32. The method of claim 22 further including the step of amplifying one or more audio signals corresponding to at least one of the audio channels by a second amplifier, and driving at least one non-directional loudspeaker by the second amplifier.

25 33. The method of claim 32 further including the step of receiving the at least one audio channel in parallel by the modulated signal generator and the second amplifier.

34. The method of claim 32 further including the steps of receiving the at least one audio channel by the

modulated signal generator, and providing a representation of the at least one audio channel to the second amplifier by the modulated signal generator.

5 35. The method of claim 32 further including the steps of selectively generating the ultrasonic carrier signal modulated with the at least one of the audio signals by the modulated signal generator, and selectively amplifying the one or more audio signals by the second amplifier,
10 thereby allowing only the directional loudspeaker, only the non-directional loudspeaker, or both the directional loudspeaker and the non-directional loudspeaker, to reproduce the audio signals.

15 36. A telephone system, comprising:
 a receiver configured to receive information representative of at least one audio signal;
 a modulated signal generator configured to generate an ultrasonic carrier signal modulated with the at least
20 one audio signal;
 a driver amplifier configured to amplify the modulated ultrasonic carrier signal; and
 at least one directional loudspeaker, the directional loudspeaker including at least one acoustic
25 transducer configured to receive the modulated ultrasonic carrier signal amplified by the driver amplifier, and to project a sound beam representing the modulated ultrasonic carrier signal through a propagation medium

along a pre-selected path to reproduce the at least one audio signal along at least a portion of the path.

37. The system of claim 36 further including a second
5 amplifier and at least one non-directional speaker, the second amplifier being configured to amplify at least one audio signal and to drive the non-directional loudspeaker.

10 38. The system of claim 37 wherein the modulated signal generator and the second amplifier are configured to receive the at least one audio channel in parallel.

15 39. The system of claim 37 wherein the modulated signal generator is configured to receive the at least one audio channel and to provide a representation of the at least one audio channel to the second amplifier.

20 40. The system of claim 37 wherein the modulated signal generator is configured to selectively generate the ultrasonic carrier signal modulated with the at least one of the audio signals, and the second amplifier is configured to selectively amplify the one or more audio signals, thereby allowing only the directional
25 loudspeaker, only the non-directional loudspeaker, or both the directional loudspeaker and the non-directional loudspeaker, to reproduce the audio signals.

41. A method of operating a telephone system, comprising the steps of:

receiving information representative of at least one audio signal by a receiver;

5 generating an ultrasonic carrier signal modulated with the at least one audio signal by a modulated signal generator;

amplifying the modulated ultrasonic carrier signal by a driver amplifier;

10 receiving the modulated ultrasonic carrier signal amplified by the driver amplifier by at least one directional loudspeaker including at least one acoustic transducer; and

15 projecting a sound beam representing the modulated ultrasonic carrier signal through a propagation medium along a pre-selected path by the directional loudspeaker, thereby reproducing the at least one audio signal along at least a portion of the path.

20 42. The method of claim 41 further including the steps of amplifying at least one audio signal by a second amplifier, and driving at least one non-directional loudspeaker by the second amplifier.

25 43. The method of claim 42 further including the step of receiving the at least one audio signal in parallel by the modulated signal generator and the second amplifier.

44. The method of claim 42 further including the steps
of receiving the at least one audio channel by modulated
signal generator, and providing a representation of the
at least one audio channel to the second amplifier by the
5 modulated signal generator.

45. The method of claim 42 further including the steps
of selectively generating the ultrasonic carrier signal
modulated with the at least one of the audio signals by
10 the modulated signal generator, and selectively amplifying
the one or more audio signals by the second amplifier,
thereby allowing only the directional loudspeaker, only
the non-directional loudspeaker, or both the directional
loudspeaker and the non-directional loudspeaker, to
15 reproduce the audio signals.